A SURVEILLANCE AND TARGETING SYSTEM FOR AN UNMANNED GROUND VEHICLE

Manuel R. Solorzano and Douglas W. Gage
Naval Ocean Systems Center
San Diego, CA

AUVS-90
Dayton OH
30 July-1 August 90

ROLES FOR RSTA PACKAGE

- DAY/NIGHT SURVEILLANCE
- REMOTE FORWARD AREA FIRE CONTROL
    - FOR ARTILLERY AND AIR SUPPORT MISSIONS
- TARGET IDENTIFICATION AND TRACKING
- ACTIVE TARGET DESIGNATION
    - HELLFIRE MISSILE
    - COPPERHEAD SMART MUNITION

MAJOR SYSTEM ELEMENTS

- SCISSORS LIFT
- PAN/TILT MOTION PLATFORM
- SENSOR SUITE
- PROCESSING/COMMUNICATIONS

SYSTEM DESIGN CONSTRAINT

USMC DIRECTION:
USE EQUIPMENTS IN THE INVENTORY WHERE AVAILABLE
- **TO MINIMIZE LOGISTICAL SUPPORT REQUIREMENTS**
- **TO MINIMIZE SYSTEM TRAINING REQUIREMENTS**

SYSTEM DESIGN CHALLENGE:
- **EQUIPMENTS NOT DESIGNED FOR REMOTE OPERATION**

LIFT DESIGN

- SCISSORS DESIGN
- ELECTRIC: DC BALL LINEAR ACTUATORS
- FOOTPRINT: 47" LONG BY 24.5" WIDE
- STOWED HEIGHT: 20"
- LIFT WEIGHT: 470 LB
- RATED PAYLOAD WEIGHT: 250 LB
  (WITH 2:1 DESIGN MARGIN)

LIFT PERFORMANCE

VARIABLE DEFILADE DEPLOYMENT:
- **15 FEET MAX HEIGHT (EURO THEATER STUDIES)**
- **9.25 FEET TRAVEL**

SPEED (200 LB LOAD):
- **RAISE IN 31 SECONDS**
- **LOWER IN 28 SECONDS**

STABILITY IN 20 KNOT GUSTING WIND:
- **DESIGN GOAL: 300 MICRORADIANS**
- **MEASURED: < 50 MICRORADIANS**

MOTION PLATFORM DESIGN

ELECTRIC PAN/TILT DRIVE
- **DC SERVO GEARED DRIVES**
- **14 BIT POSITION RESOLUTION**

FOUR CONTROL MODES:
- **POSITION CONTROL (HIGH/LOW GAIN)**
- **VELOCITY CONTROL (HIGH/LOW GAIN)**
- **TRACKING OUTPUT**
  (TO ALLOW SLAVING, POSITION REPORTS)

MOTION PLATFORM PERFORMANCE

MAXIMUM PAN/TILT SLEW RATE

- **DESIGN GOAL: 28 DEG/SEC, CORRESPONDING TO 100 KM/HR TARGET AT 100 METERS RANGE**
- **MEASURED: 26 DEG/SEC**

MINIMUM CONTROLLABLE SLEW RATE

- **DESIGN GOAL: 0.1 DEG/SEC, CORRESPONDING TO 2 KM/HR TARGET AT 3 KM RANGE**
- **MEASURED: 0.15 DEG/SEC**

SENSOR SUITE

LASER RANGER/DESIGNATOR
AN/PAQ-3 MULE (MFR: HUGHES)

FLIR
AN/TAS-4 (MFR:KOLLMORGEN)

ACOUSTICAL DETECTION SYSTEM
ADS (MFR: NOSC)

LLL/ZOOM VIDEO
(MFR: NOSC)

AN/PAQ-3 MULE CHARACTERISTICS

- LASER
  - NDYAG LASER, 1060 NM (1.06 MICRONS)
  - 80 MILLIJOULES/PULSE, NOT EYE SAFE
- TIME-OF-FLIGHT RANGER
  - MAXIMUM RANGE: 10 KM
  - MINIMUM RANGE: ADJUSTABLE DOWN TO 170 M
  - PRECISION: 10 M
- DESIGNATOR: PROGRAMMABLE CODING
  - 30 PULSES/SEC MAX
- CONTROL INTERFACE:RANGE/DESIGNATE MODE, MULE POWER ON/OFF, CAMERA POWER ON/OFF, TRIGGER ON/OFF, RANGE DATA ACQUISITION

AN/TAS-4 FLIR CHARACTERISTICS

- 128 ELEMENT ARRAY
  MECHANICALLY SWEPT TO GENERATE 2-D IMAGE
- CENTER FREQUENCY: APPROX 10 MICRON
- FIELD OF VIEW (FOV): APPROX 20 DEG
- MECHANICALLY BORESIGHTED TO MULE
- CONTROL INTERFACE: LOCAL/REMOTE, NORM/FREEZE, FIELD/FRAME, RETICLE ON/OFF, HOT BLACK/WHITE, FOCUS IN/OUT, CONTRAST IN/OUT, BRIGHTNESS IN/OUT

LOW LIGHT LEVEL VIDEO CHARACTERISTICS

- SWITCHABLE SUPER-INTENSIFIED TV (S.I.T)
  GOAL: SURVEILLANCE WITH 1/4 MOON
- CCD ARRAY, 2/3 INCH FORMAT
  LINE RESOLUTION: 800 (COHU) OR 480 (PULNIX)
- ZOOM RATIO: 20:1
- COMPUTER GENERATED RETICLE
- REMOTE CONTROL OF ZOOM, FOCUS, BRIGHTNESS
  (AUTOMATIC IRIS IN NORMAL OPERATION)
- MECHANICALLY BORESIGHTED TO MULE
- CONTROL INTERFACE: POWER ON/OFF, ZOOM IN/OUT, FOCUS IN/OUT

ACOUSTICAL DETECTION SYSTEM CHARACTERISTICS

- SELECTABLE INFRASONIC AND ULTRASONIC FREQUENCY SHIFTING CAPABILITY
- SUPER-BINAURAL CONFIGURATION
  - ANGLE AND PICKUP SEPARATION GREATER THAN HUMAN HEAD
- VARIABLE GAIN WITH CLIPPING
- INTEGRATABLE INTO TOV OPERATOR HELMET
- CONTROL INTERFACE: VOLUME UP/DOWN, SONIC ON/OFF, ULTRA ON/OFF, INFRA ON/OFF, BOOST HI/MED/OFF

LASER SAFETY IMPLICATIONS

IMPLICATIONS FOR DESIGN:

- POWER UP SEQUENCE
- ABORT/RECOVERY SEQUENCE
- COMPLEMENTARY TRIG/TRIGBAR SIGNAL PAIR

IMPLICATIONS FOR DEVELOPMENT PROGRAM:

- TEST LASER ONLY ON GUNNERY RANGE
  - COMPETE WITH USMC, HUNTERS, BISON

SURVEILLANCE SYSTEM WEIGHT BUDGET

FLIR	23.4		
MULE	15.1		
MULE SUPPORT	5.1		
LLL VIDEO	18.5		
ADS	3.0		
TOTAL SENSORS		65	
CABLE ASSEMBLIES		25	
MOTION PLATFORM		98	
TOTAL LIFT PAYLOAD			190
WEIGHT OF LIFT			470
TOTAL SURVEILLANCE SYSTEM			660 POUNDS

SURVEILLANCE SYSTEM POWER BUDGET

LIFT:

30 A @ 24 V PEAK

15 A @ 24 V AVERAGE

FAIL-SAFE BRAKE: HOLDS POSITION WITH ZERO POWER

PAN/TILT MOTION PLATFORM:

4A @ 24 V PEAK, < 0.5 A TYPICAL

< 0.05 A STANDBY

MULE:

RANGING MODE: 2 A @ 24 V

DESIGNATION MODE: 4 A @ 24 V AVG, 20 A PEAKS

FLIR:

16 A @ 24 V (PRIMARILY COOLING LOAD)

FIBER OPTIC COMMUNICATIONS LINK

- VIDEO
  - 2 CHANNELS, 6 MHZ B/W, 7 BIT ENCODING
- AUDIO
  - 2 CHANNELS, 18 KHZ B/W
- SERIAL DATA
  - 8 CHANNELS, 38.4 KBPS MAX

- 200 MBPS TOTAL

RV COMPUTER RESOURCES

- 3 PROCESSORS: RV, SURVEILLANCE, MULE
- MODIFIED STD BUS FORMAT (AIRBORNE CONNECTORS)
- CPU CARDS:
  - WIN SYSTEMS SBC80C88
  - 32KB EPROM, 32 KB RAM
- MEMORY & I/O CARDS:
  - 1 MB RAM
  - 8 CHANNEL 12 BIT A/D
  - 8 CHANNEL 12 BIT D/A
  - PARALLEL I/O: 32 BITS IN, 32 BITS OUT

CONCLUSIONS

- IT WORKS (SUCCESSFUL DEMONSTRATIONS)

- LESSONS LEARNED:
    - COMPUTERS ARE OUR FRIENDS
    - CABLING CAN KILL YOU
    - ARCHITECTURE IS IMPORTANT
        (CONTROL/PROCESSING/COMMUNICATIONS)